DATE: November 3, 2009

TO: Jeff Catanzarita, U.S. EPA/ERT Work Assignment Manager

THROUGH: Richard Leuser, SERAS Deputy Program Manager

FROM: Christopher Gussman, SERAS Task Leader

SUBJECT: PROPOSED SAMPLING AT THE LOWER LEY CREEK SUPERFUND SITE ***DRAFT*** WA # SER0007 - TECHNICAL MEMORANDUM

Purpose. Scientific Engineering Response Analytical Service (SERAS) personnel will provide technical support to the Environmental Protection Agency/Environmental Response Team (EPA/E RT) and EPA Region II during sediment and biological sampling efforts at the Lower Ley Creek Superfund Site in Syracuse, New York (NY). The purpose of this sampling effort is to determine the extent and distribution of contamination in Lower Ley Creek and to document adverse ecological and/or human health impact for justification of removal action. Technical support will involve collecting biological samples (Fish, crayfish), and sediment samples from a two mile stretch of the Lower Ley Creek upstream of O nondaga Lake. The data will be used to support an ecological risk assessment (ERA).

Background. The Lower Ley Creek Site consists of channel sediments and surface water, and floodplain soil/sediment from the Brewerton Road (U.S. Route 11) bridge downs tream to Onondaga Lake. Ley Creek has been impacted by a number of facilities located near the creek including the GM Inland Fisher guide facility located in East Syracuse, New York. The facility operated between 1952 and 1993. Initially it operated as a plating facility and later was used for the manufacture of plastic automotive components. Lower Ley Creek has received a wide range of contaminants, principally in the form of Polychlorinated biphenyls PCBs and heavy metals. PCBs (Aroclors 1016, 1248, 1254, and 1260) were detected in Lower Ley Creek at concentrations as high as 360,000 ug/kg. The Onondaga Lake Remedial Investigation report estimated PCB loads of 23 kg/yr, 3.3 kg/yr, and 1.1 kg/yr of Aroclors 1016, 1242, and 1260, respectively. Cadmiu m, chromium, copper, lead, mercury, and nickel were also detected at elevated levels in Ley Creek sediment. Sediment data obtained near the mouth of Ley Creek suggest that Ley Creek is a source of Polychlorinated Dibenzo -Dioxin/Polychlorinated Dibenzo -Furans (PCDD/PCDFs) to Onondaga Lake. Based on the above, Ley Creek is a source of PCBs, heavy metals, and a likely source of PCDD/PCDFs to the lake, and may be contributing to unacceptable human health and ecological risks in Onondaga Lake due to consumption of fish.

For the ERA, dietary exposure to site contaminants of concern (COCs) is expected to be the most important exposure pathway. This WA will focus on assessing the bioaccumulation of COCs

Sampling Dates. The goal is to conduct the sampling of fish and crayfish the week of November 9, 2009. Sediment sampling is anticipated to take place the week of November 16, 2009.

Sampling Matrices. Sampling will include sediment, water, edible fish, forage fish, and crayfish It is anticipated that greater than 30 but less than 50 sediment sampling location will be selected, with three sampling depth (0 -6", 6 -12", and 18 -24" below sediment surface) to be sampled at each location if possible. In addition, there will be 10 sur face water samples and samples of edible fish, forage fish, and crayish. Table 1 outlines sample numbers, matrices, and analyses.

SERAS Responsibilities. SERAS will collect the samples. Once the samples are collected and placed in an appropriate sample container, they will be turned over to EPA/DESA for sample management and analysis.

Statistical Support of Sampling Design. A Visual Sampling Plan (VSP) was selected for sediment sampling. For the VSP, Lower Ley Creek was broken into three reaches based on physical and known chemical characteristics .The iteration selected was run looking for a 200 ft. diameter circular hotspot with 95% confidence. It resulted in 30 sample locations although there are some gaps in sampling (where the creek narrows a triangular grid can't be fit). In addition to the 30 sampling locations produced by this design, up to 20 additional sampling locations may be selected in the field to fill in data gaps and examine locations in the field of interest such as sediment depositional areas. Figure 1 illustrates the 30 sampling locations. The information below summarizes the VSP design.

Triangular Grid – 95% Confidence – Circular Hot Spot – 200 ft. Diameter

Systematic sampling locations for detecting an area of elevated values (hot spot)

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	20
Type of samples	Point Samples
Number of samples on map [a]	30
Number of selected sample areas [b]	3
Specified sampling area [c]	629327.71 ft^2
Grid pattern	Triangular
Size of grid / Area of grid [d]	193.205 feet / 32327.1 ft^2
Total cost of sampling [e]	Not Applicable (N/A)

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place samples.

Area: Area 1					
X Coord	Y Coord	Label	Value	Type	Historical
929548.2758	1120653.4848			Hotspot	
929258.4686	1120820.8050			Hotspot	
930031.2877	1120820.8050			Hotspot	
930127.8901	1120988.1253			Hotspot	

Area: Area 2					
X Coord	Y Coord	Label	Value	Type	Historical
930498.2882	1121474.9333			Hotspot	
930594.8906	1121642.2535			Hotspot	
930691.4930	1121809.5738			Hotspot	
930788.0953	1121976.8940			Hotspot	
930884.6977	1122144.2143			Hotspot	
930981.3001	1122311.5345			Hotspot	
931077.9025	1122478.8548			Hotspot	
931560.9145	1122980.8155			Hotspot	
931657.5169	1123148.1358			Hotspot	
931754.1193	1123315.4561			Hotspot	
931850.7217	1123482.7763			Hotspot	
931947.3241	1123650.0966			Hotspot	
932043.9265	1123817.4168			Hotspot	
932140.5289	1123984.7371			Hotspot	
932237.1313	1124152.0573			Hotspot	
932333.7337	1124319.3776			Hotspot	
932430.3360	1124486.6978			Hotspot	

Area: Area 3					
X Coord	Y Coord	Label	Value	Type	Historical
933211.9323	1125316.4267			Hotspot	
933405.1371	1125316.4267			Hotspot	
933598.3419	1125316.4267			Hotspot	
933791.5467	1125316.4267			Hotspot	
933984.7515	1125316.4267			Hotspot	
935240.5826	1125818.3875			Hotspot	
935530.3898	1125985.7077			Hotspot	
935723.5945	1125985.7077			Hotspot	
935916.7993	1125985.7077			Hotspot	

Primary Sampling Objective
The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-□.

Selected Sampling Approach
This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

Number of Total Samples: Calculation Equation and Inputs
The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer and Wickman for locating geologic deposits [see Singer and Wickman (1969) and Hassig et al. (2004) for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on the given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

Parameter	Description	Value
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
Sample Type	Point samples or square cells	Points
Hot Spot Shape	Hot spot height to width ratio	1
Hot Spot Size	Length of hot spot semi-major axis	100 feet
Hot Spot Area [a]	Area of hot spot (Length^2 * Shape * π)	31415.9 ft^2
Angle	Angle of orientation between hot spot and grid	Random
Sampling Area	Total area to sample	629327.71 ft^2
Outputs		
Grid Size	Spacing between samples	193.205 feet
Grid Area	Area represented by one grid	32327.1 ft^2
Samples [b]	Optimum number of samples	19.4675
Cost	Total cost of sampling	N/A

[a] Length of semi-major axis is used by Singer-Wickman algorithm. Hot spot area is provided for informational purposes.
[b] The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between the number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).

Assumptions that Underlie the VSP Locating a Hot Spot Design Method

1. The shape of the hot spot of concern is circular or elliptical.
2. The level of contamination that defines a hot spot is well defined.
3. The location of the hot spot is unknown, and if a hot spot is present, all locations within the sampling area are equally likely to contain the hot spot.
4. Samples are taken on a square, rectangular or triangular grid pattern.
5. Each sample is collected, handled, measured or inspected using approved methods that yield unbiased and sufficiently precise measurements.
6. A very small proportion of the surface being studied will be sampled (the sample is much smaller than the hot spot of interest).
7. Sample locations are independent of the measurement process.
8. The systematic grid is placed at a randomly determined starting place to cover the surface area of interest.
9. There are no classification errors (if a hot spot is sampled, it is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the probability of hit (%), hot spot shape (height to width ratio) and hot spot size (length of semi-major axis). The following table shows the results of this analysis.

Number of Samples				
		Size=50	Size=100	Size=150
1-β=90	Shp=0.8	95	24	11
	Shp=0.9	82	21	10
	Shp=1	73	19	9
1-β=95	Shp=0.8	104	26	12
	Shp=0.9	89	23	10
	Shp=1	78	20	9
1-β=100	Shp=0.8	126	32	14
	Shp=0.9	109	28	13
	Shp=1	97	25	11

1-β = Probability of Hit (%)
Shp = Hot Spot Shape (Height to Width Ratio)
Size = Hot Spot Size (Length of Semi-major Axis)

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2006). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

A map of the actual sample locations will be generated so that the sampling plan and the field implementation may be compared. Deviations from planned sample locations due to topographic, vegetative, or other features will be noted. Their impacts will be qualitatively assessed. If a hot spot is discovered, additional sampling may be performed to determine its size and shape, in which case, the initial assumptions of the sampling design may then be assessed and/or reconsidered.

Method of Water and Sediment Sampling. Surface water sampling will be conducted in accordance with SERAS standard operating procedure (SOP) # 2013, *Surface Water Sampling*. A direct collection method is preferred, where the appropriate sample container is immersed in the water and permitted to fill. The container opening should be below the surface of the water and facing upstream. The sample should be collected from a point upstream of the sampler. Surface water sample collection should be conducted prior to disturbance of the substrate at a ny specific location by field personnel or sampling equipment. If field personnel must enter the water to collect the sample, substrate should be allowed to settle or disperse with the stream current before sampling. Surface water samples will be collect ed in certified-clean containers for analysis of VOCs, SVOCs, and metals, in sequential order. The VOC fraction should be collected by initially filling one 1 -liter amber bottle to be used for the SVOC fraction and slowly transferring the water from the a mber bottle to individual sample containers pre -preserved with hydrochloric acid. The metals fraction will be preserved with nitric acid (pH < 2) after collection.

Sediment sampling will be conducted in accordance with SERS SOP #2016, *Sediment Sampling*. Samples will be collected from three sediment intervals: 0 to 6 inches, 6 to 12 inches, and 18 to 24 inches below the water-sediment interface. Sediment sampling procedures should not be initiated until surface water sampling has been conducted at the l ocation, if applicable. Sampling should be conducted from the upper interval (0 to 6 inches) to the lower interval (18 to 24 inches). The middle and lower intervals will be collected in an acetate sleeve using a manually driven coring device. The upper interval may be collected similarly or by using an Ekman or Ponar dredge. If refusal is met, a second attempt will be made within 3 -feet of the selected location. If refusal is still met that particular location/depth may be

abandoned. Diver-assisted core sampling may be required depending on location -specific conditions. Sediment samples will be collected in certified -clean containers for analysis of VOCs, SVOCs, pesticides/PCBs, and metals. Sample fractions for dioxin analysis will also be collect ed from the upper interval at 10 unspecified locations. The VOC fraction will be collected first directly from the dredge or core, followed in order by SVOC, pesticide/PCB, dioxin (where collected) and metals fractions . Nondisposeable sampling equipment will be decontaminated after each sampling location.

Sample containers will be submitted from SERAS to DESA. DESA will perform sample management and send the samples to a CLP laboratory.

Ecological Sampling. Biota will be collected and analyzed that the results may be used in a human health and ecological risk assessment. Two different fish species commonly consumed by anglers will be harvested, as well as a forage fish species and crayfish . Actual species used will depend on species present a t the time of collection. Food fish collection will be divided into two general locations: Upstream of I81 but below 7 th Street and Upstream of 7 th street but below Route 11. Forage fish and crayfish will be collected from three general areas: Just up stream of I81, just upstream of 7 th street, just downstream of Rt. 11. Fish collections will be performed using electroshocker equipment provided by EPA Region II. Additional fish may or may not be caught with nets or seines. Crayfish will be collected by hand using kicknets or collected in commercial, baited crayfish traps. Numbers and analysis of each may be found in Table 1.

Tissue from commonly consumed fish species will be removed in the same way they would be prepared for human consumption. The preference will be for the collected of the left side fillet. However, i f there is insufficient mass for analyses the right side fillet may also be used. Filets will have the scales removed but include the skin. Compositing of fish tissue samples shall follow guidance on sampl e preparation for human health risk assessments and/or OSWER directive 9200.1 -77D (Using Fish Tissue Data to monitor Remedy Effectiveness 2007). Composites shall be a single species and of comparable size. Unless otherwise stated, the sampling goal shall be to collect enough fish to meet the mass requirements and/or 5individuals per composite and 5 replicate composites per sampling area. Each fish shall be given an ID, weight and length shall be recorded and a scale sample (when appropriate) shall be collected , labeled and retained for potential aging . Information on each composite shall include the identification of the fish species that comprised the composite. Within a given composite there shall be approximately equal mass of tissue for each fish in the composite; the mass of tissue from each fish in a composite, shall be recorded.

Forage fish and crayfish will be collected from three general locations (Figu re 2) Composites of forage fish shall be of single specie and of approximately the same size. The average size of the individuals within each composite will be determined and the weight and length recorded. Total number of individuals will also be recor ded. The stomach and lower gastrointestinal tract may be removed from species which have ingested or are known to ingest a large amount of sediment.

Crayfish will be of a single species and will consist of in dividuals of comparable size. A sample will consist of ten individuals per sample or more if mass is not sufficient. Crayfish will be depurated for 12 - 24 hours in site water prior to processing.

Samples will be homogenized before placing in appropriate containers. Sample containers will be submitted from SERAS to DESA. DESA will perform sample management and send the samples to a CLP laboratory.

References

EPA 2006. *Data Quality Assessment: Statistical Methods for Practitioners EPA QA/G -9S*, EPA/240/B-06/003, U.S. Environmental Protection Agency, Office of Environmental Information, Washington DC.

Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring* . Wiley & Sons, Inc., New York, NY.

Hassig, N.L., J.E. Wilson, R.O. Gilbert and B.A. Pulsipher. 2004. *Visual Sample Plan Version 3.0 User's Guide*. PNNL-14970. Pacific Northwest National Laboratory, Richland, WA, December 2004.

Singer, D.A. and J.E. Wickman. 1969. *Probability Tables for Locating Elliptical Targets with Square, Rectangular, and Hexagonal Point Nets* . Pennsylvania State University, University Park, Pennsylvania. Special Publication 1-69.

Table1
Sample Matrices and Analyses
Lower Ley Creek Sampling Plan-DRAFT
November 3, 2009

SEDIMENT				ECOLOGICAL			
COC	Locations	Number of samples/location	Total	Edible Fish	Forage Fish	Crayfish	Water
VOC	50	3	150	0	0	0	10
BNA	50	3	150	0	0	0	10
Metals & Hg	50	3	150	20	9	9	20*
PCB/PESTICIDES	50	3	150	20	9	9	0
Dioxin	10	1	10	4	3	3	0
			0				
		Total	610				

CLP QA/QC samples not included
NOTE: no dioxin or pesticide /PCBs analyses on water samples
* 10 total and 10 filtered
Note: Sediment Dioxin to be collected at 10 locations at 0-6" interval
Note: 50 locations indicate 30 designated locations and *up to* 20 additional selected in the field.